Compiling Fuzzy Logic Control Rules to Hardware Implementations

Stephen Chiu and Masaki Togai
Rockwell International Science Center, Thousand Oaks, California 91360

A major aspect of human reasoning involves the use of approximations. Particularly in situations where the decision-making process is under stringent time constraints, decisions are based largely on approximate, qualitative assessments of the situations. This work is concerned with the application of approximate reasoning to real-time control. Because of the stringent processing speed requirements in such applications, hardware implementations of fuzzy logic inferencing are being pursued. A programming environment for translating fuzzy control rules into hardware realizations is described. Two methods of hardware realizations are possible. The first is based on a special-purpose chip for fuzzy inferencing. The second is based on a simple memory chip. The ability to directly translate a set of decision rules into hardware implementations is expected to make fuzzy control an increasingly practical approach to the control of complex systems.

Address correspondence to S. Chiu.

Modifiable Combining Functions

Paul R. Cohen
EKSL, Computer and Information Science, University of Massachusetts, Amherst, Massachusetts 01003
Glenn Shafer and Prakash P. Shenoy
School of Business, University of Kansas, Lawrence, Kansas 66045

Modifiable combining functions are a synthesis of two general approaches to combining evidence. Because they facilitate the acquisition, representation, explanation, and modification of expert knowledge about combinations of evidence, they are presented as a device for knowledge engineers, not as a normative theory of evidence combination. The basic idea of modifiable combining functions is to acquire degrees of belief for a subset of all possible combinations of evidence and then infer degrees of belief for other combinations in the set. If, in the course of knowledge engineering, a particular degree of belief is challenged, then it (and others) can be modified by an appropriate method.

Address correspondence to P. R. Cohen

Steps Toward Programs that Manage Uncertainty

Paul R. Cohen
Department of Computer and Information Science, University of Massachusetts, Amherst, Massachusetts 01003

Reasoning under uncertainty in AI has come to mean assessing the credibility of hypotheses inferred from evidence. But techniques for assessing credibility do not tell a problem solver what to do when it is uncertain. The paper discusses a medical expert system called MUM, for Managing Uncertainty in Medicine, that plans diagnostic sequences of questions, tests, and treatments, describes the kinds of problems that MUM was designed to solve, and gives a brief description of its architecture. More recently, an empty version of MUM called MU has been built and used to reimplement MUM and a small diagnostic system for plant pathology. Certain features of MU make it appropriate for building expert systems that manage uncertainty.

An Algorithm for Computing Probabilistic Propositions

Gregory F. Cooper
Medical Computer Science Group, Knowledge Systems Laboratory, Stanford University, Medical School Office Building, Room 217, Stanford, California 94305

An algorithm for computing probabilistic propositions is presented. It assumes the availability of a single external routine for computing the probability of one instantiated variable, given a conjunction of other instantiated variables. Although the time complexity of the algorithm is exponential in the size of a query, it is polynomial in the size of a number of common types of queries.

Combining Symbolic and Numeric Approaches to Uncertainty Management

Bruce D. D'Ambrosio
Department of Computer Science, Oregon State University,

Uncertainty is represented in an assumption-based truth maintenance system (ATMS) by tokens called assumptions, which are used to represent belief in uncertain facts. Given a set of assumptions and a set of inferences that can be drawn from these assumptions and their consequents, the ATMS derives a complete Boolean expression (label) for the truth value of every proposition in the database, expressed in terms of the original assumption tokens. Thus, an ATMS can be viewed as a symbolic algebra system for uncertainty reasoning. Previously, assumptions have always been taken to be truth variables ranging over Boolean truth values. This paper describes a method of attaching numeric certainty estimates to assumptions and deriving numeric truth values from the labels of ATMS propositions. This technique has several major advantages over conventional methods for performing inference with numeric certainty estimates, including improved management of dependent and partially independent evidence, faster run-time evaluation of propositional certainties, and the ability to query the certainty value of a proposition from multiple perspectives.

The Inductive Logic of Information Systems

Norman C. Dalkey
Cognitive Systems Laboratory, Computer Science Department,